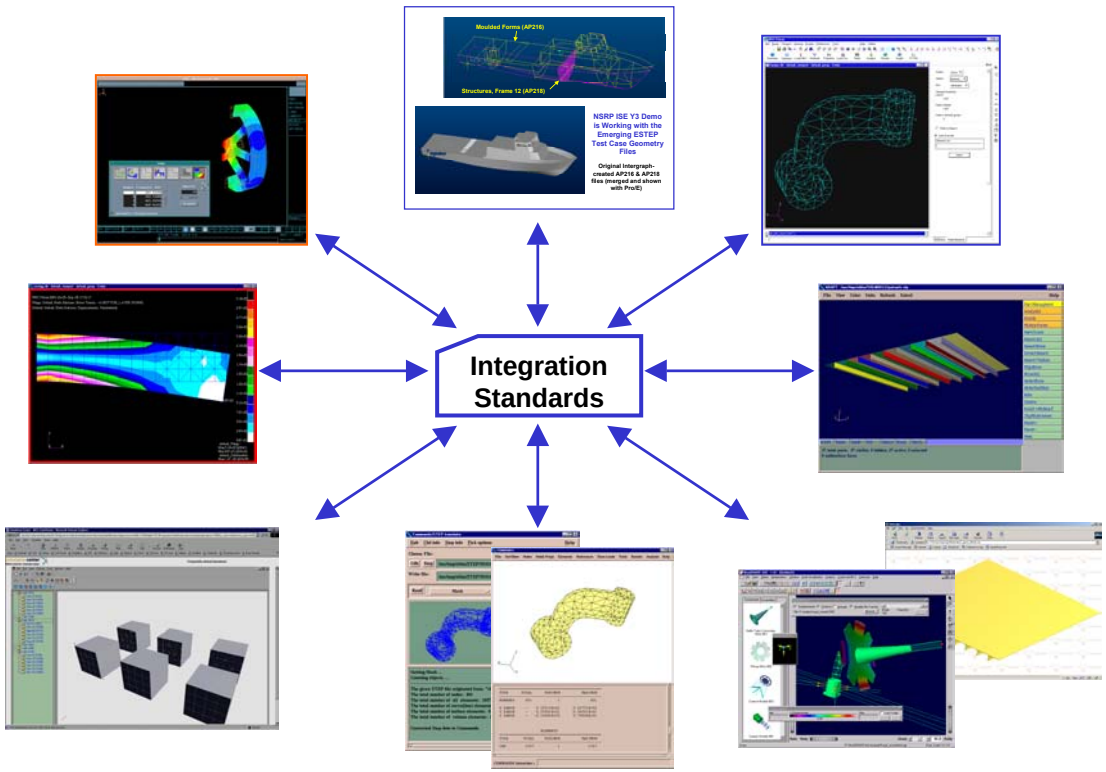
Modeling & Simulation for Emergency Response



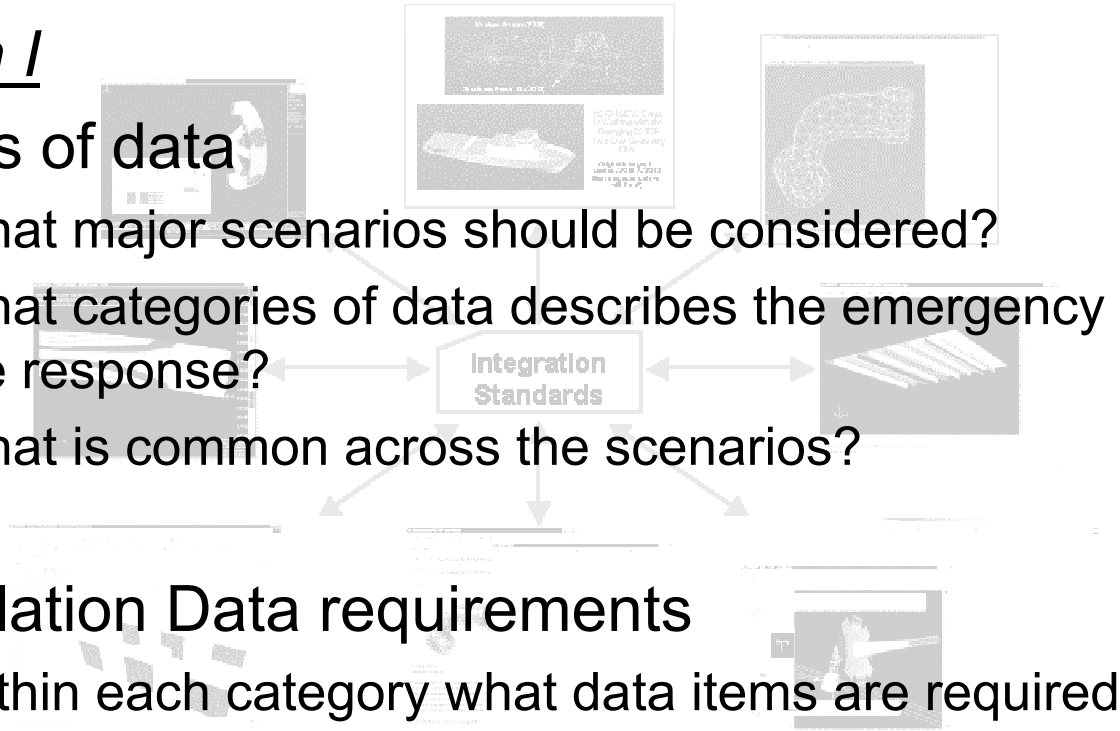
Data Requirements

Mike Stiteler, ATI

“The great thing about standards is that there are so many of them.”

For Multi-Discipline Modeling & Simulation, this is not a joke; this is a necessity!

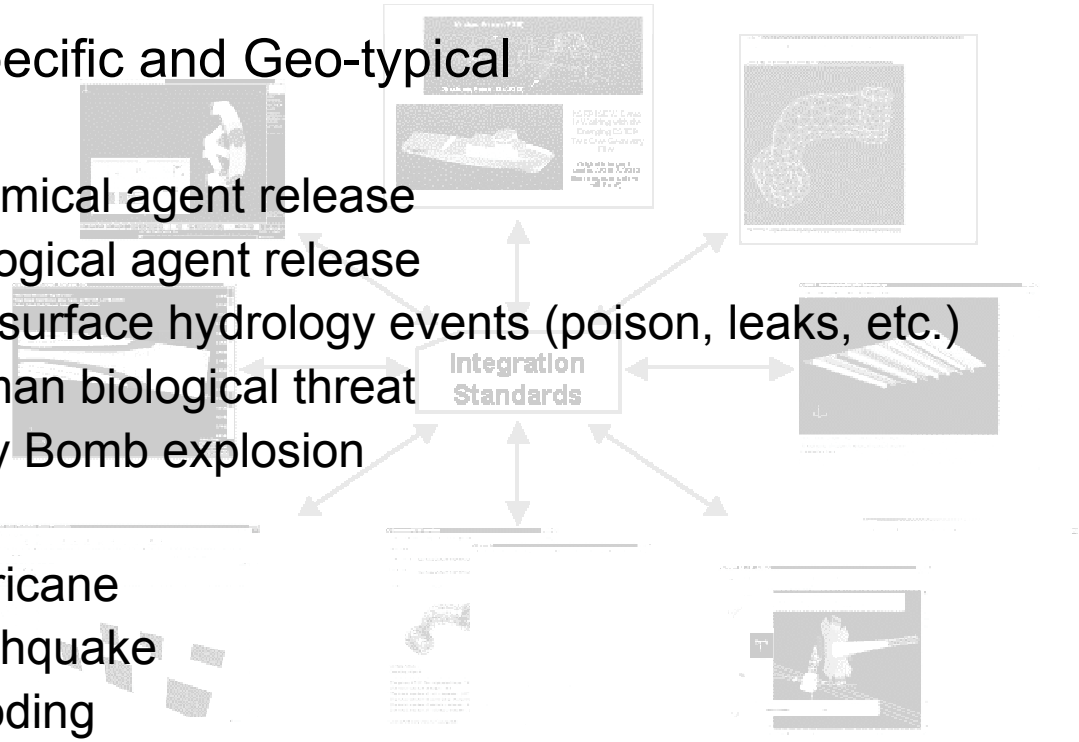
Data Requirements



Session I

- Types of data
  - What major scenarios should be considered?
  - What categories of data describes the emergency event and the response?
  - What is common across the scenarios?
- Simulation Data requirements
  - Within each category what data items are required for simulation?
- Data sources
  - Where are the required data available?

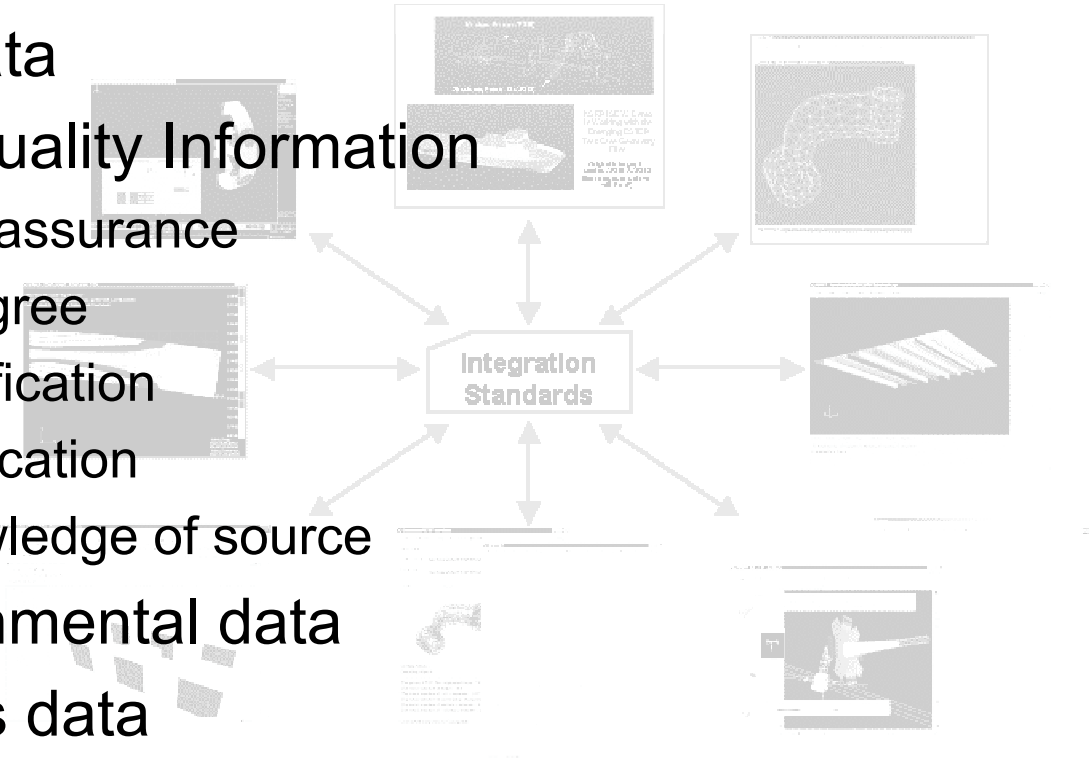
Emergency Response Scenarios for Discussion of Data Items



- Geo-specific and Geo-typical
- Human
  - Chemical agent release
  - Biological agent release
  - Subsurface hydrology events (poison, leaks, etc.)
  - Human biological threat
  - Dirty Bomb explosion
- Natural
  - Hurricane
  - Earthquake
  - Flooding
  - Fires
  - Volcanic Eruptions
- Specific Scenarios
  - Evacuation

Simulation Data Requirements - I

- Metadata
- Data Quality Information
  - data assurance
  - Pedigree
  - Certification
  - Verification
  - Knowledge of source
- Environmental data
- Census data
- General physical data



Data and Sources

TYPE OF DATA	*POTENTIAL DATA SOURCES*
Terrain data	US Geological Survey
Streets/highway data	City offices Map software companies Atlas publishers
Response agency locations and Response plans	City office , police, fire and health departments
Utility and infrastructure locations	Utility companies, telecom companies
Weather	NOAA
Population density	US Census Bureau
Business area population density, Transportation patterns	Local transportation departments
City evacuation plans	City office
Building design records	City office, building management
Building evacuation plans	Building security
Space Information (near & Far)	NOAA

Data and Sources

TYPE OF DATA	*POTENTIAL DATA SOURCES*
Source characterization	Civil support teams/First responders
	Source reference materials (some sources will be classified)
Analysis results (simulation results)	Simulations!
Sampling measurements	On seen personnel/apparatus
Specialized attributes vice bulk data	-We know it's out there-Where? -Centralized database (in future)
Other systems data (infinite possibilities) Issue is data exchange	Adherence to data exchange standards (semantic, syntactic)
Health-related data (patient,	CDC, Secure patient database
diseases, prophylactics, diagnoses)	
Exposure history	Interview, then document & share
Critical infrastructure	NISAC, State/Local Gov.

Data and Sources

TYPE OF DATA	*POTENTIAL DATA SOURCES*
Agricultural product characteristics	USGS, Dept. of Ag., STATSGO
Human behavior/performance, Organizational behavior	-No central organization that we know of! –Intelligence services -Human factors labs -Israel?
Equipment characteristics & performance	Manufacturers
Location/inventory of equipment	Many locations (owners of equip.)
Location of data (index)	Database, but which? National spatial data clearinghouse (NSDI)
Ocean information (ports, depth, currents, waves, etc.)	-Navy -NOAA
Emergency response language	Model after ICAO/NATO?
Hazards Labels	DTRA, OSHA (MSDS)
Human physical characteristics	Air force (Sandy Ressler, NIST), choreography notation standard

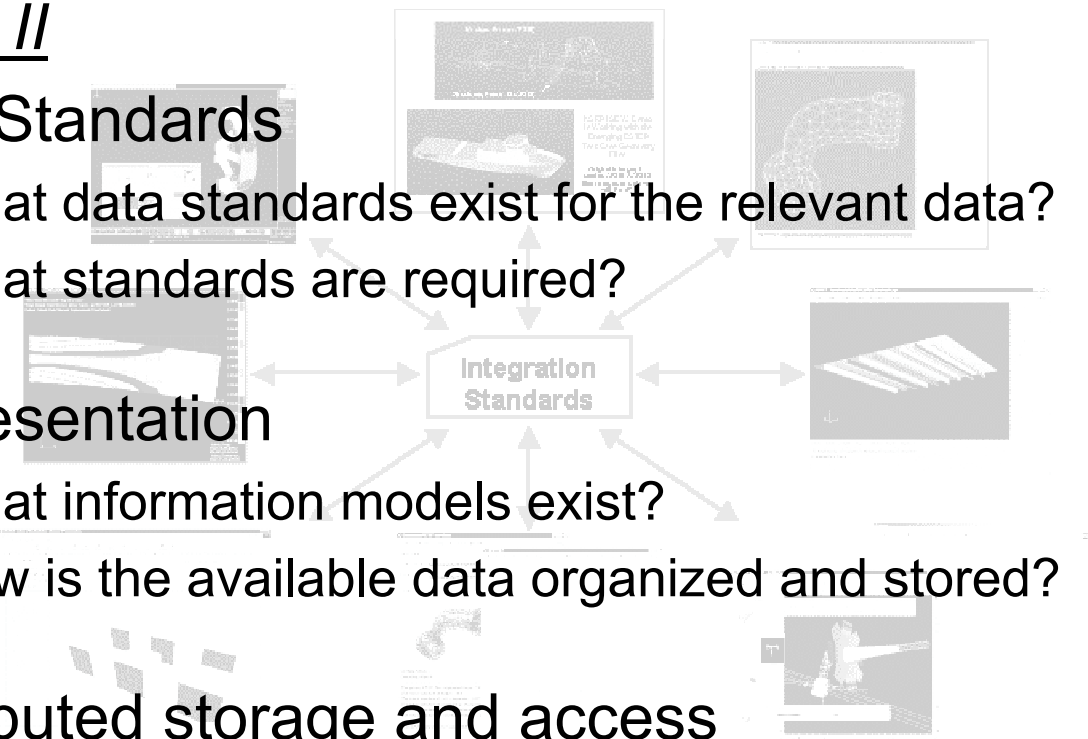
Data Requirements-I Summary

- Obvious need for data exchange standards
- Need detailed literature search to document development of specifications and de facto standards
- Need for metadata for data sets (basis, authoritative sources)
- Need for accessible data archives (indexes, repositories)
- “Reference Part” paradigm for common data requirements (no need to duplicate common model components)

Data Requirements

Session II

- Data Standards
  - What data standards exist for the relevant data?
  - What standards are required?
- Representation
  - What information models exist?
  - How is the available data organized and stored?
- Distributed storage and access
  - What distributed storage and access mechanisms are needed?
- Other related topics

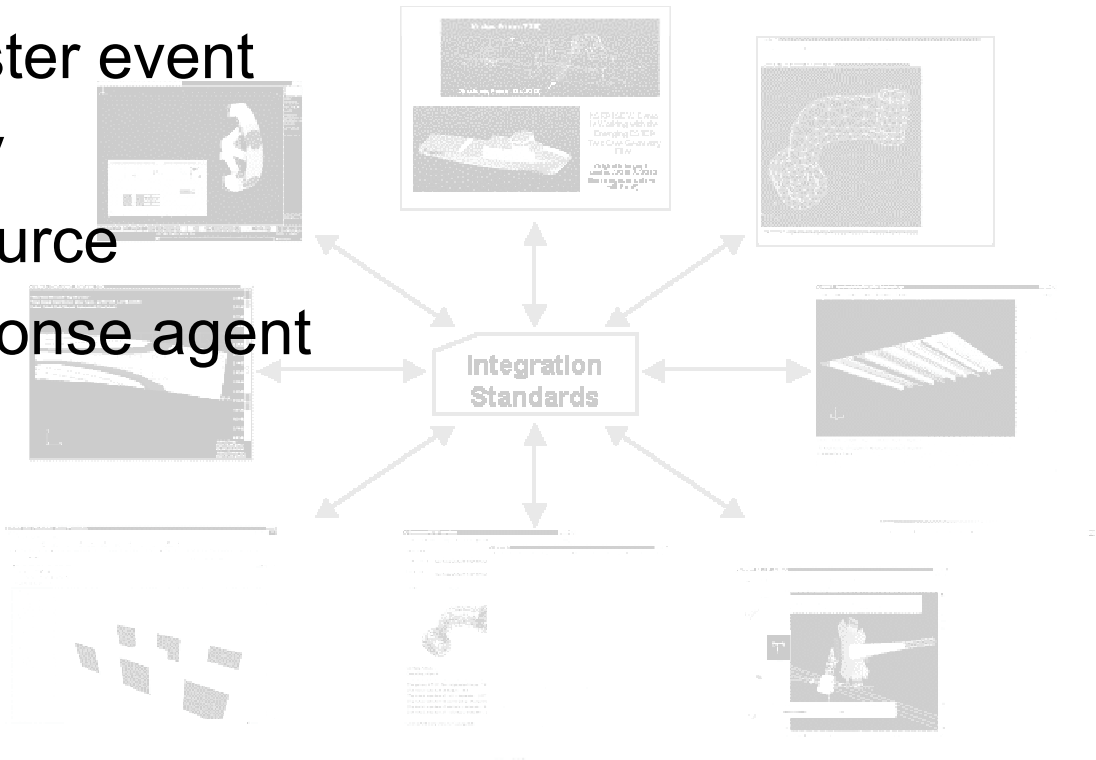


Data Standards Bodies/Users

- Intelligence Community Metadata Standards
- EPA Biological, Chemical, Facility standards
- FAA standards on National Airspace System
- IEEE standards for intelligent transportation systems
- ASHRAE standards for building automation and control networks
- US Health Information Knowledgebase
- OASIS Emergency Management Technical Committee (announced Feb. 2003)
- ISO standards for physical data exchange (CAD, PDM, Electro-mechanical, Engineering Analysis,…)

Required Data Standards

- Disaster event
- Entity
- Resource
- Response agent
- Area
- …….

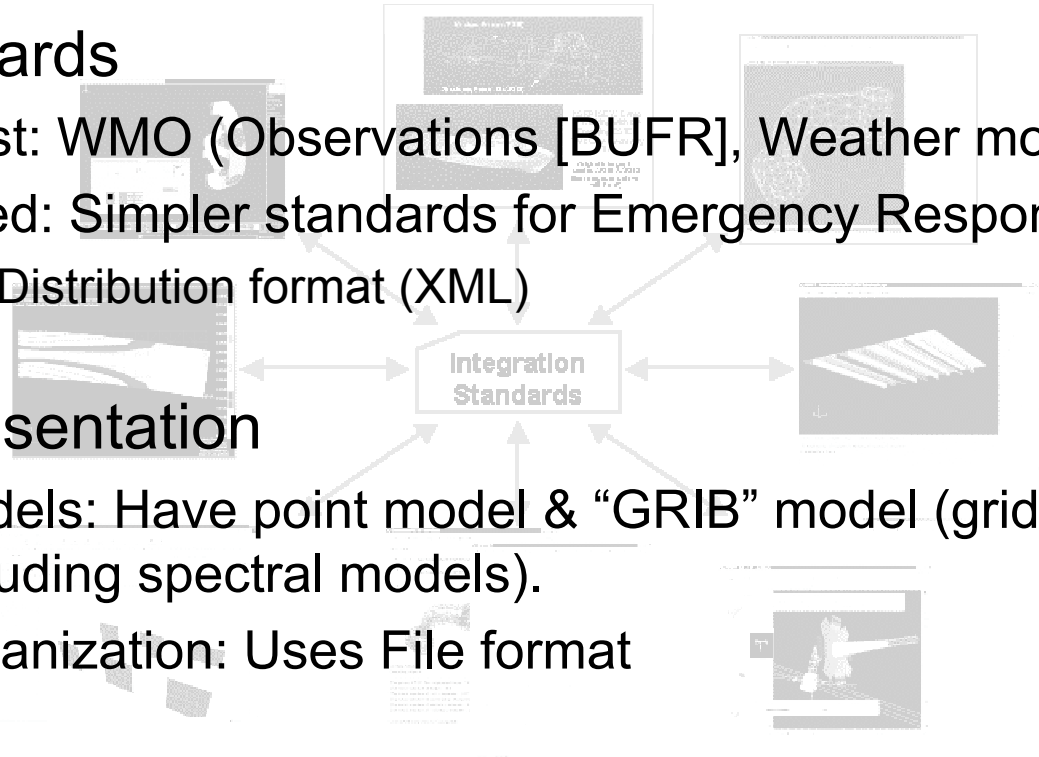


Data Representation Models

- ISO/IEC 11179-X Information technology - Specification and standardization of data elements
- W3C Extensible Markup Language (XML) 1.0
- ISO/IEC 14772-1:1998, Information technology - Computer graphics and image processing - The Virtual Reality Modeling Language
- ISO/TC 211 Geographic Information/ Geomatics
- ISO/10303 AP203 (CAD), AP210 (Electro-mechanical), AP209 (Analysis)

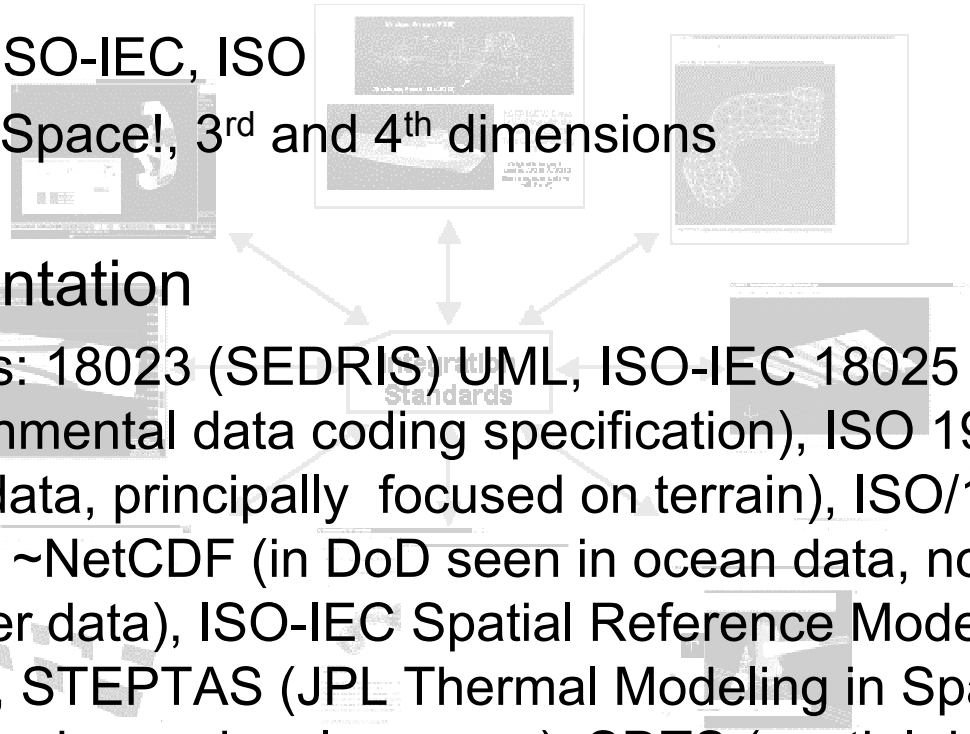
Weather

- Standards
  - Exist: WMO (Observations [BUFR], Weather models)
  - Need: Simpler standards for Emergency Response
    - Distribution format (XML)
- Representation
  - Models: Have point model & “GRIB” model (grid data including spectral models).
  - Organization: Uses File format



Terrain/Ocean/Weather/Space*

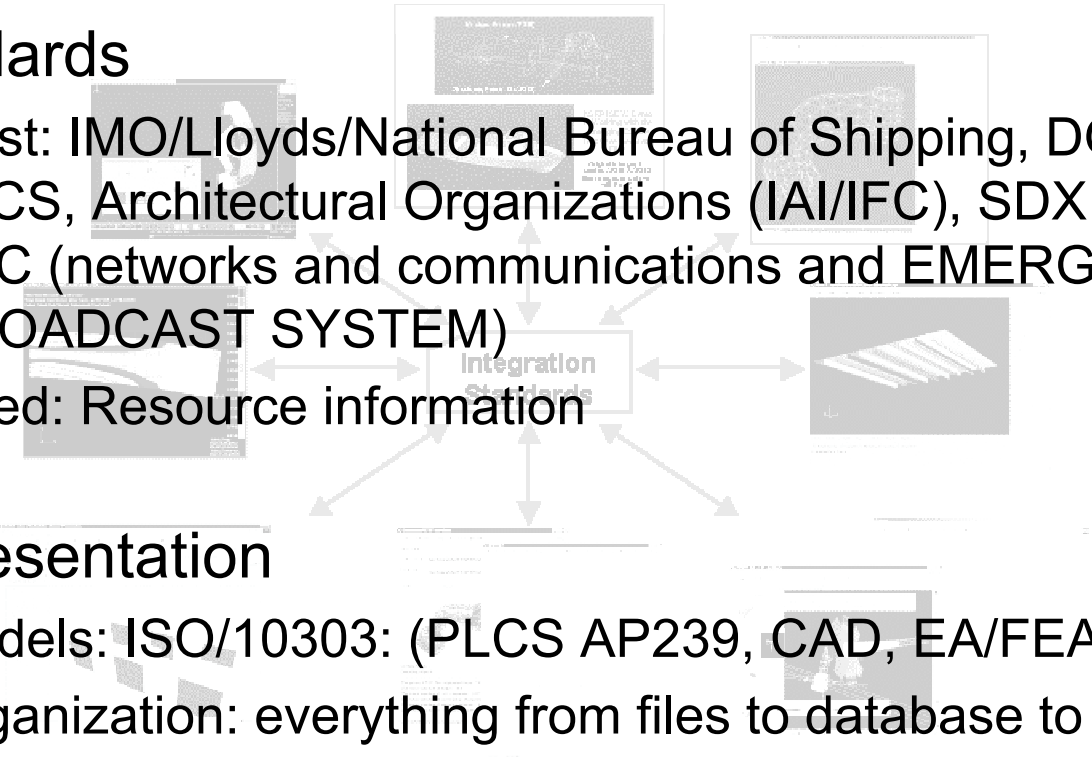
- Standards
  - Exist: ISO-IEC, ISO
  - Need: Space!, 3rd and 4th dimensions
- Representation
  - Models: 18023 (SEDRIS) UML, ISO-IEC 18025 (EDCS, environmental data coding specification), ISO 19115 (metadata, principally focused on terrain), ISO/10303 STEP, HDF?, ~NetCDF (in DoD seen in ocean data, not much in weather data), ISO-IEC Spatial Reference Model ISO-IEC 18026, STEPTAS (JPL Thermal Modeling in Space), GML (geography markup language), SDTS (spatial data transfer standard)
  - Organization: Specified transmittal format (file), Specified access format



* Terrain models may include manmade structures

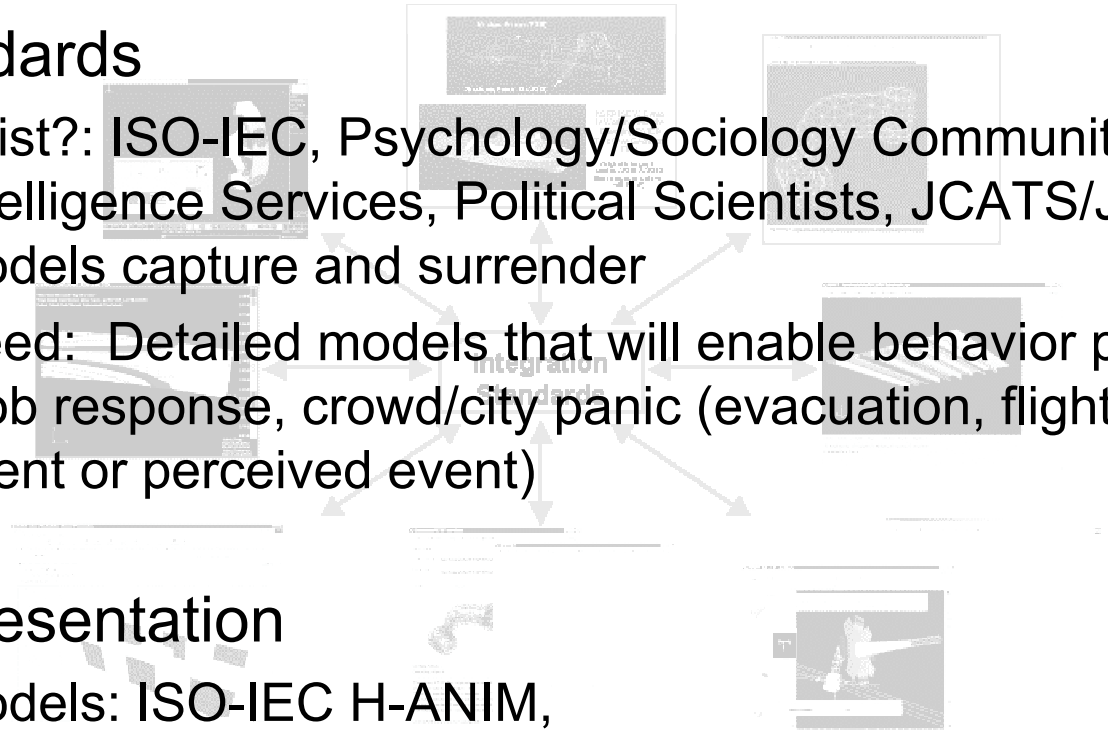
Manmade Systems

- Standards
  - Exist: IMO/Lloyds/National Bureau of Shipping, DOT, FAA, PLCS, Architectural Organizations (IAI/IFC), SDX (NIST), FCC (networks and communications and EMERGENCY BROADCAST SYSTEM)
  - Need: Resource information
- Representation
  - Models: ISO/10303: (PLCS AP239, CAD, EA/FEA),
  - Organization: everything from files to database to XML



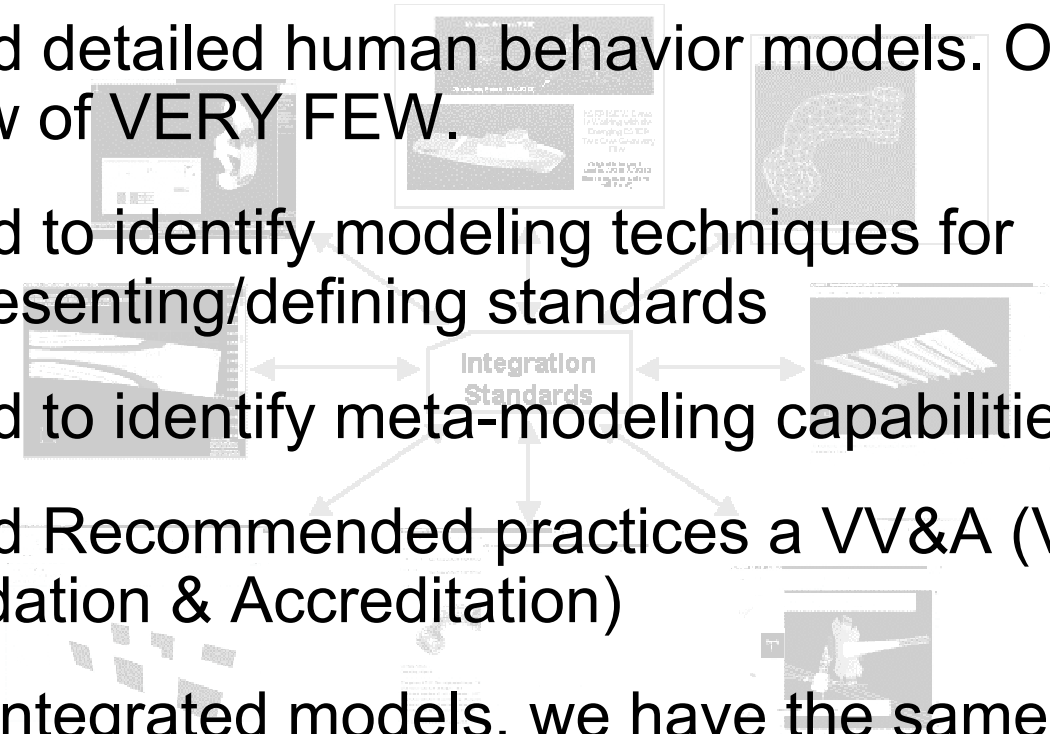
Human Behavior

- Standards
  - Exist?: ISO-IEC, Psychology/Sociology Communities, Intelligence Services, Political Scientists, JCATS/JTLS models capture and surrender
  - Need: Detailed models that will enable behavior predictions, mob response, crowd/city panic (evacuation, flight from event or perceived event)
- Representation
  - Models: ISO-IEC H-ANIM,
  - Organization: Web3D supporting H-ANIM,



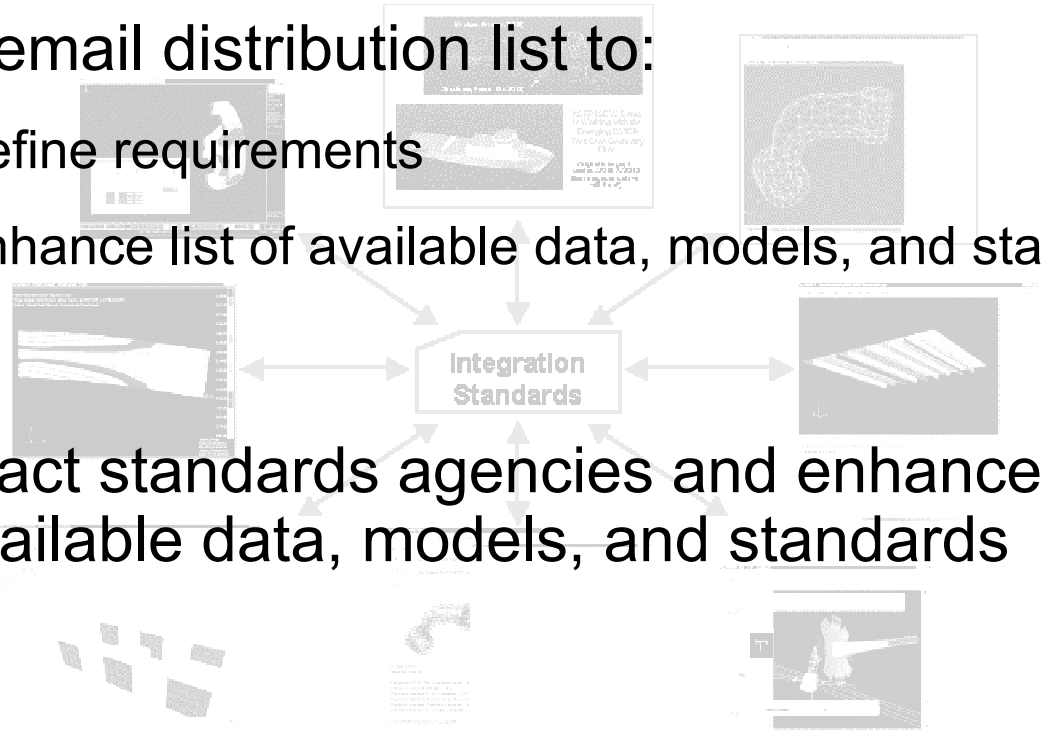
Data Requirements-II Summary

- Need detailed human behavior models. Our team knew of VERY FEW.
- Need to identify modeling techniques for representing/defining standards
- Need to identify meta-modeling capabilities
- Need Recommended practices a VV&A (Verification, Validation & Accreditation)
- For integrated models, we have the same requirement of standard formats for both data input and output



Data Requirements-Action Items

- Use email distribution list to:
  - Refine requirements
  - Enhance list of available data, models, and standards



- Contact standards agencies and enhance knowledge of available data, models, and standards

Contact: Mike Stiteler, Stiteler@aticorp.org

Backup Slides

Simulation data requirements - II

RESOURCES *Sim. Data:*	*Yes*	*No*
• *Status*	√	
• *Mobility*	√	
• *Target index*	√	
• *Linked entities*	√	
• *Parent organization*	√	
• *Role*	√	
• *Live/ Equipment*	√	
• …….		

Categories of data

DISASTER EVENT	*RESOURCES*	*RESPONSE AGENTS*
• *Status*	• *Status*	• *Status*
• *Mobility*	• *Mobility*	• *Mobility*
• *Potential impact zone*	• *Target index*	• *Target index*
• *Impacted entities*	• *Linked entities*	• *Quantity*
• *Effect on entities*	• *Parent organization*	• *Information latency*
• *Duration*	• *Role*	• *Role*
• *Lifecycle pattern*	• *Live/ Equipment*	• *Live/ Equipment*
• *Growth pattern*	• …….	• ……..
• …….		

Simulation data requirements - I

DISASTER EVENT	*Sim. Data:*	*Yes*	*No*
• *Status*		√	
• *Mobility*		√	
• *Potential impact zone*		√	√*
• *Impacted entities*		√	√*
• *Effect on entities*		√	√*
• *Duration*		√	
• *Lifecycle pattern*		√	
• *Growth pattern*		√	
• ……..			

* - Simulation outputs

Simulation data requirements - III

RESPONSE AGENTS *Sim. Data:*	*Yes*	*No*
• *Status*	√	
• *Mobility*	√	
• *Target index*	√	
• *Quantity*	√	
• *Information latency*	√	
• *Role*	√	
• *Live/ Equipment*	√	
• ……..		